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(54) **A POLISHING PAD AND A METHOD FOR MAKING A POLISHING PAD WITH COVALENTLY BONDED PARTICLES**

POLIERKISSEN UND VERFAHREN ZUM HERSTELLEN VON POLIERKISSEN MIT KOVALENT GEBUNDENEN PARTIKELN

TAMPON A POLIR A PARTICULES LIEES PAR COVALENCE ET SON PROCEDE DE FABRICATION

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- **PATENT ABSTRACTS OF JAPAN vol. 95, no. 8, 29 September 1995 & JP 07 135192 A (SONY CORP.), 23 May 1995, & DATABASE WPI Section PQ, Week 9529 Derwent Publications Ltd., London, GB; Class PU, AN 95-221696 (29) & JP 07 135 192 A (SONY CORP.) , 23 May 1995**
- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 461 (E-0987), 5 October 1990 & JP 02 186656 A (HITACHI LTD.), 20 July 1990,**

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Description

Technical Field

[0001] The present invention relates to polishing pads used in chemical-mechanical planarization of semiconductor wafers, and, more particularly, to polishing pads with abrasive particles embedded in the body of the pad, according to independant claims 1, 7, 10, 16, 19, 23.

Background of the Invention

[0002] Chemical-mechanical planarization ("CMP") processes remove materials from the surface layer of a wafer in the production of ultra-high density integrated circuits. In a typical CMP process, a wafer presses against a polishing pad in the presence of a slurry under controlled chemical, pressure, velocity, and temperature conditions. The slurry solution has abrasive particles that abrade the surface of the wafer, and chemicals that oxidize and/or etch the surface of the wafer. Thus, when relative motion is imparted between the wafer and the pad, material is removed from the surface of the wafer by the abrasive particles (mechanical removal) and by the chemicals in the slurry (chemical removal).

[0003] CMP processes must consistently and accurately produce a uniform, planar surface on the wafer because it is important to accurately focus optical or electromagnetic circuit patterns on the surface of the wafer. As the density of integrated circuits increases, it is often necessary to accurately focus the critical dimensions of the photo-pattern to within a tolerance of approximately 0.5 μm. Focusing the photo-patterns to such small tolerances, however, is very difficult when the distance between the emission source and the surface of the wafer varies because the surface of the wafer is not uniformly planar. In fact, several devices may be defective on a wafer with a non-uniform planar surface. Thus, CMP processes must create a highly uniform, planar surface.

[0004] In the competitive semiconductor industry, it is also desirable to maximize the throughput of the finished wafers and minimize the number of defective or impaired devices on each wafer. The throughput of CMP processes is a fimction of several factors, one of which is the rate at which the thickness of the wafer decreases as it is being planarized (the "polishing rate") without sacrificing the uniformity of the planarity of the surface of the wafer. Accordingly, it is desirable to maximize the polishing rate within controlled limits.

[0005] The polishing rate of CMP processes may be increased by increasing the proportion of abrasive particles in the slurry solution. Yet, one problem with increasing the proportion of abrasive particles in colloidal slurry solutions is that the abrasive particles tend to flocculate when they are mixed with some desirable oxidizing and etching chemicals. Although stabilizing chemicals may prevent flocculation of the abrasive particles, the stabilizing chemicals are generally incompatible with the oxidizing and etching chemicals. Thus, it is desirable to limit the proportion of abrasive particles in the slurry solution.

[0006] One desirable solution for limiting the proportion of abrasive particles in the slurry is to suspend the abrasive particles in the pad. Conventional suspended particle pads are made by admixing the abrasive particles into a matrix material made from monomer chains. An ionic adhesion catalyst, such as hexamethyldisalizane, may be used to enhance adhesion between the particles and the monomer chains. After the abrasive particles are mixed into the matrix material, the matrix material is cured to harden the pad and suspend the abrasive particles throughout the matrix material. In operation, the suspended abrasive particles in the pad abrade the surface of the wafer to mechanically remove material from the wafer.

[0007] One problem with conventional suspended particle polishing pads is that the abrasiveness of the planarizing surface of the pad, and thus the polishing rate of a wafer, varies from one area to another across the surface of the pad. Before the matrix material is cured, the abrasive particles commonly agglomerate into high density clusters, causing a non-uniform distribution of abrasive particles throughout the pad. Therefore, it would be desirable to develop a suspended particle polishing pad with a uniform distribution of abrasive particles throughout the pad.

[0008] Another problem with conventional suspended particle polishing pads is that they tend to scratch the surface of the wafer. As the pad planarizes a wafer, the matrix material adjacent to abrasive particles on the planarizing surface of the polishing pad wears down; eventually, some of the abrasive particles break away from the pad and travel in the slurry. Particles also break away from pads with ionic adhesion catalysts because electrostatic solvents weaken the ionic bonds between the matrix material and the particles. When a large agglomeration of suspended particles breaks away from the pad, it may scratch the surface of the wafer and seriously damage several of the devices on the wafer. Therefore, it would be desirable to develop a pad that substantially prevents abrasive particles from breaking away from the pad.

[0009] The EP-A-0227294 describes abrasive articles comprising abrasive particles embedded in a cured binder composition adhering to a backing.

Summary of the Invention

[0010] The inventive polishing pad is used for planarizing semiconductor wafers with a CMP process; the polishing pad has a body, molecular bonding links, and abrasive particles dispersed substantially uniformly throughout the body. The body is made from a polymeric matrix material, and the molecular bonding links are covalently attached to the matrix material. Substantially

all of the abrasive particles are also covalently bonded to at least one molecular bonding link. The molecular bonding links securely affix the abrasive particles to the matrix material to enhance the uniformity of the distribution of the abrasive particles throughout the pad and to substantially prevent the abrasive particles from breaking away from the pad.

[0011] In a method for making the inventive bonded particle polishing pad, molecular bonding links are covalently bonded to abrasive particles. After the molecular bonding links are covalently bonded to the abrasive particles, the bonded molecular bonding links and abrasive particles are admixed with a matrix material in a mold. During the admixing step, reactive terminus groups of the molecular bonding links bond to the matrix material to securely affix the particles to the matrix material. The matrix material is then cured to form a pad body with bonded abrasive particles that are suspended substantially uniformly throughout the body.

Brief Description of the Drawings

[0012]

Figure 1 is a partial cross-sectional view of a conventional polishing pad with suspended abrasive particles in accordance with the prior art

Figure 2 is a partial schematic cross-sectional view of a polishing pad with bonded, suspended particles in accordance with the invention.

Figure 3 is a schematic view of a molecular bonding link and an abrasive particle in accordance with the invention.

Figure 4A is a chemical diagram of a molecular bonding link and abrasive particle in accordance with the invention.

Figure 4B is a chemical diagram of the reaction between a molecular bonding link and an abrasive particle in accordance with the invention.

Figure 5 is a flow chart illustrating a method of making a polishing pad with bonded, suspended particles in accordance with the invention.

Detailed Description of the Invention

[0013] The polishing pad of the present invention has a uniform distribution of abrasive particles throughout the pad, and the abrasive particles are covalently bonded to the pad to substantially prevent the abrasive particles from breaking away from the pad. An important aspect of the present invention is to provide molecular bonding links that covalently bond to both the matrix material of the polishing pad and the abrasive particles. The molecular bonding links perform the following advantageous functions: (1) substantially prevent the abrasive particles from agglomerating before the matrix material is cured; and (2) secure the abrasive particles to the matrix material. The molecular bonding links, therefore, enhance the uniformity of the distribution of the abrasive particles throughout the matrix material and substantially prevent the abrasive particles from breaking away from the polishing pad.

[0014] Figure 1 illustrates a conventional polishing pad P formed from a matrix material 12 and a number of abrasive particles 20. The abrasive particles 20 are suspended in the matrix material 12 while the matrix material 12 is in a liquid state. Before the matrix material 12 cures, the abrasive particles 20 may agglomerate into clusters 22 that reduce the uniformity of the distribution of the abrasive particles 20 throughout the matrix material 12. Thus, when a planarizing surface S of the pad P is conditioned to a new planarizing surface S_c, the polishing rate over the cluster 22 of abrasive particles 20 is different than that of other areas on the pad. Additionally, as the matrix material 12 wears down during planarization or conditioning, abrasive particles 20 near the planarizing surface tend to break away from the pad P and scratch a wafer (not shown). Thus, conventional suspended particle polishing pads may provide erratic polishing rates and damage the wafers.

[0015] Figure 2 illustrates a polishing pad 10 in accordance with the invention. The polishing pad 10 has a body 11 made from a matrix material 12. The matrix material 12 is generally polyurethane or nylon. The above-listed polymeric materials are merely exemplary, and thus other polymeric matrix materials are within the scope of the invention. The molecular bonding links 30 covalently bond to the matrix material 12 and the abrasive particles 20. The molecular bonding links 30, therefore, secure the abrasive particles 20 to the matrix material 12. The abrasive particles 20 are preferably made from silicon dioxide or aluminum oxide, but other types of abrasive particles are within the scope of the invention.

[0016] Figure 3 further illustrates the bond between a strand of matrix material 12, a bonding link 30, and an abrasive particle 20. The molecular bonding link 30 has an alkyl chain 32, a reactive terminus group 34, and a particle affixing group 36. The reactive terminus group 34 is a molecular segment that bonds the bonding link 30 to the strand of the matrix material 12. The specific structure of the reactive terminus group 34 is selected to reactively bond with the specific type of matrix material 12 when the matrix material 12 is in a liquid monomer phase. The particle affixing group 36 is another molecular segment that covalently bonds the bonding link 30 to the abrasive particle 20. The specific structure of the particle affixing group 36 is similarly selected to covalently bond with the material from which the abrasive particles 20 are made. Accordingly, the molecular bonding link 30 securely attaches the abrasive particle 20 to the matrix material 12.

[0017] Figure 4A illustrates a specific embodiment of the molecular bonding link 30. The alkyl chain 32 is made from $(CH_2)_n$, where n=1-30, the reactive terminus group is made from COOH, and the particle affixing

group is made from trichlorosilane. Referring to Figure 4B, the trichlorosilane molecule reacts with the O-H chains on the surface of the particle 20 to covalently bond the abrasive particle 20 to the particle affixing group 36 of the molecular bonding link 30. Similarly, the COOH reactive terminus group 34 reacts with a urethane monomer chain 12 to bond the bonding link 30 to the matrix material 12. The byproducts of the reaction are water and hydrochloric acid.

[0018] The invention is not limited to abrasive particles made from silicon dioxide or a matrix material made from polyurethane. The materials from which the abrasive particles and the matrix material are made can be varied to impart desired characteristics to the pad. A central aspect of the invention is to select molecular bonding links that covalently bond to the abrasive particles and matrix material to substantially prevent the bonds between the matrix material, molecular bonding links, and abrasive particles from weakening in the presence of an electrostatic solvent. Additionally, the length of the alkyl chain 32 of the molecular bonding link 30 may be varied to accommodate different sizes of abrasive particles 20. For example, an alkyl chain 15-20Å in length (approximately twelve carbon atoms $(CH_2)_{12}$) may be used with a 1,500Å diameter particle. Longer alkyl chains 32 are preferably used with larger abrasive particles 20, and shorter alkyl chains 32 are preferably used with smaller abrasive particles 20.

[0019] Figure 5 graphically illustrates a method for making bonded particle polishing pads for use in chemical-mechanical planarization of semiconductor wafers in accordance with the invention. The first step 200 of the method is to fill a mold with a matrix material in a liquid monomer phase. The second step 202 is to covalently bond abrasive particles to molecular bonding links. Depending upon the desired length of the molecular bonding links, they are deposited onto the abrasive particles either by vapor deposition (shorter lengths) or by liquid deposition (longer lengths). The third step 204 is to admix the bonded molecular bonding links and abrasive particles with the matrix material. The pad is made from approximately 10%-50% by weight abrasive particles and bonding links, and approximately 50%-90% by weight matrix material 12. In a preferred embodiment, the pad is made from approximately 15%-25% by weight of bonded abrasive particles and bonding links. After the bonded abrasive particles and molecular bonding links are disbursed substantially uniformly throughout the matrix material, the fourth step 206 is to cure the matrix material.

[0020] One advantage of the present invention is that the polishing pad results in a high polishing rate without limiting the oxidizing or etching chemicals in the slurry. By putting the abrasive particles 20 in the pad 10, stabilizing agents are not required in the slurry solution. Accordingly, a wider range of etching and oxidizing chemicals may be used in the slurry solution.

[0021] Another advantage of the present invention is that the polishing pad 10 has a uniform polishing rate across its planarizing surface. By bonding the abrasive particles 20 to the matrix material 12, the abrasive particles 20 do not agglomerate into large clusters 22, as shown in Figure 1. The polishing pad 10, therefore, has a substantially uniform distribution of abrasive particles 20 throughout the matrix material. Thus, the polishing rate is substantially uniform across the surface of the wafer.

[0022] Still another advantage of the invention is that the polishing pad 10 does not create large scratches on the surface of a wafer. By covalently bonding the abrasive particles 20 to the matrix material 12, the abrasive particles 20 do not readily break away from the pad 10 in the presence of an electrostatic solvent. Thus, compared to conventional pads, large clusters 22 of abrasive particles 20 are less likely to break away from the pad 10 and scratch a wafer during planarization.

[0023] From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

Claims

1. A semiconductor wafer polishing pad, comprising:

   - a body made from a polymeric matrix material;
   - abrasive particles; and
   - molecular bonding links; the molecular bonding links comprising a reactive terminus group at one end thereof and a particle affixing group at another end thereof, the reactive terminus group covalently bonding to the matrix material and the particle affixing group covalently bonding to an abrasive particle, thereby affixing the abrasive particles to the matrix material in a substantially uniform distribution throughout the body and in a manner capable of substantially maintaining the affixation between the abrasive particles and the matrix material in the presence of an electrostatic chemical-mechanical planarization slurry.

2. The polishing pad of claim 1 wherein the matrix material is made from polyurethane.

3. The polishing pad of claim 1 wherein the abrasive particles are made from silicon dioxide.

4. The polishing pad of claim 1 wherein the abrasive particles are made from aluminum oxide.

5. The polishing pad of claim 1 wherein the matrix material is made from polyurethane and the abrasive

particles are made from silicon dioxide.

6. The polishing pad of claim 5 wherein the reactive terminus group is COOH, and the particle affixing group is a trichlorosilane, the trichlorosilane covalently bonding with a hydroxylated silicon surface on the abrasive particles.

7. A method for making a bonded particle polishing pad for use in chemical-mechanical planarization of semiconductor wafers, comprising the steps of:

filling a mold with a matrix material;
covalently bonding molecular bonding links to abrasive particles, each molecular bonding link having a reactive terminus group at one end for covalently bonding the molecular bonding link to the matrix material and a particle affixing group at another end for covalently bonding the molecular bonding link to an abrasive particle;
admixing the bonded abrasive particles and molecular bonding links with the matrix material, the molecular bonding links covalently bonding to the matrix material to securely affix the abrasive particles to the matrix material; and
curing the matrix material to form a pad body with bonded abrasive particles that are suspended substantially uniformly throughout the body.

8. The method of claim 7 wherein the matrix material is made from a polymeric material.

9. The method of claim 7 wherein the admixing step comprises admixing 10% to 50% by weight of bonded abrasive particles and molecular bonding links with the matrix material.

10. A planarizing machine for chemical-mechanical planarization of a semiconductor wafer, comprising:

a platen;
a polishing pad positioned on the platen, the polishing pad having a body made from a polymeric matrix material, abrasive particles; and molecular bonding links, the molecular bonding links having a reactive terminus group at one end thereof for covalently bonding to the matrix material and a particle affixing group at another end for covalently bonding to an abrasive particle , thereby affixing the abrasive particles to the matrix material throughout the body during chemical-mechanical planarization in the presence of an electrostatic chemical-mechanical planarization slurry, and
a wafer carrier positionable over the polishing pad, the wafer being attachable to the wafer carrier, wherein at least one of the platen or the wafer carrier is moveable to engage the wafer with the polishing pad and to impart motion between the wafer and polishing pad.

11. The planarizing machine of claim 10 wherein the matrix material is made from polyurethane.

12. The planarizing machine of claim 10 wherein the abrasive particles are made from silicon dioxide.

13. The planarizing machine of claim 10 wherein the abrasive particles are made from aluminum oxide.

14. The planarizing machine of claim 10 wherein the matrix material is made from polyurethane and the abrasive particles are made from silicon dioxide.

15. The planarizing machine of claim 10 wherein the reactive terminus group is COOH, and the particle affixing group is a trichlorosilane, the trichlorosilane covalently bonding with a hydroxylated silicon surface on the abrasive particles.

16. A polishing pad, comprising:

- a body made from a polymeric matrix material;
- non-hydrolyzed molecular bonding links;
- abrasive particles;

the molecular bonding links having a reactive terminus group at one end for covalently bonding to the matrix material and a particle affixing group at another end for covalently bonding to an abrasive particle and affixing the abrasive particles to the matrix material during chemical-mechanical planarization.

17. The polishing pad of claim 16 wherein the abrasive particles have a coat of molecular bonding links applied by vapor deposition.

18. The polishing pad of claim 16 wherein the matrix material is polyurethane and the abrasive particles are silicon dioxide, and wherein each molecular bonding link has a reactive terminus group of COOH and a particle affixing group of trichlorosilane, the reactive terminus group being a molecule segment at one end of the molecular bonding link that covalently bonds to the matrix material and the particle affixing group being another molecule segment at another end of the molecular bonding link.

19. A polishing pad, comprising:

- a body made from a polymeric matrix material, the body being between approximately 50% and 90% by weight of the polishing pad;
- non-hydrolyzed molecular bonding links;
- abrasive particles being between approximate-

ly 10% and 50% by weight of the polishing pad;

the molecular bonding links having a reactive terminus group at one end for covalently bonding to the matrix material and a particle affixing group at another end for covalently bonding to an abrasive particle and affixing the abrasive particles to the matrix material during chemical-mechanical planarization.

20. The polishing pad of claim 19 wherein the abrasive particles have a coat of molecular bonding links applied by vapor deposition.

21. The polishing pad of claim 19 wherein the abrasive particles are between approximately 15% and 25% by weight of the polishing pad.

22. The polishing pad of claim 19 wherein the matrix material is polyurethane and the abrasive particles are silicon dioxide, and wherein each molecular bonding link comprises a reactive terminus group of COOH and a particle affixing group of trichlorosilane, the reactive terminus group being a molecule segment at one end of the molecular bonding link that covalently bonds to the matrix material and the particle affixing group being another molecule segment at another end of the molecular bonding link that covalently bonds to an abrasive particle.

23. A polishing pad, comprising:

- a body made from a polymeric matrix material;
- non-hydrolyzed molecular bonding links;
- abrasive particles having an average particle size of less than 0.15 μm;

the molecular bonding links having a reactive terminus group at one end for covalently bonding to the matrix material and a particle affixing group at another end for covalently bonding to an abrasive particle and affixing the abrasive particles to the matrix material during chemical-mechanical planarization in the presence of an electrostatic chemical-mechanical planarization solution.

24. The polishing pad of claim 23 wherein the abrasive particles have an average particle size less than 0.1 μm.

25. The polishing pad of claim 23 wherein the body is between approximately 50% arid 90% by weight of the polishing pad and the abrasive particles are between approximately 10% and 50% by weight of the polishing pad.

Patentansprüche

1. Halbleiterwafer-Polierkissen aufweisend:

- einen aus einem polymeren Matrixmaterial hergestellten Körper,
- Schleifteilchen, und
- Molekülbindungsglieder,

wobei die Molekülbindungsglieder an einem ihrer Enden eine reaktive Endgruppe und an einem anderen ihrer Enden eine Teilchen-Befestigungsgruppe aufweisen, wobei die reaktive Endgruppe kovalent an das Matrixmaterial bindet und die Teilchen-Befestigungsgruppe kovalent an Schleifteilchen bindet, wodurch die Molekülbindungsglieder die Schleifteilchen an das Matrixmaterial binden in einer im wesentlichen gleichförmigen Verteilung überall im Körper und in einer Weise, die es ermöglicht, die Bindung zwischen den Schleifteilchen und dem Matrixmaterial in Anwesenheit einer elektrostatische Aufschlämmung für chemisch-mechanische Planarisierung aufrecht zu erhalten.

2. Polierkissen nach Anspruch 1, bei dem das Matrixmaterial aus Polyurethan hergestellt ist.

3. Polierkissen nach Anspruch 1, bei dem die Schleifteilchen aus Siliciumdioxid hergestellt sind.

4. Polierkissen nach Anspruch 1, bei dem die Schleifteilchen aus Aluminiumoxid hergestellt sind.

5. Polierkissen nach Anspruch 1, bei dem das Matrixmaterial aus Polyurethan hergestellt ist und die Schleifteilchen aus Siliciumdioxid hergestellt sind.

6. Polierkissen nach Anspruch 5, bei dem die reaktive Endgruppe COOH ist und die Teilchen-Befestigungsgruppe ein Trichlorsilan ist, wobei das Trichlorsilan kovalent an eine hydroxylierte Siliciumoberfläche auf den Schleifteilchen bindet.

7. Verfahren zur Herstellung eines Polierkissens mit gebundenen Teilchen zur Verwendung bei der chemisch-mechanischen Planarisierung von Halbleiterwafern, folgende Schritte aufweisend:

Füllen einer Form mit einem Matrixmaterial,
kovalent Binden von Molekülbindungsgliedern an Schleifteilchen, wobei jedes Molekülbindungsglied eine reaktive Endgruppe an einem Ende zum kovalent Binden des Molekülbindungsglieds an das Matrixmaterial und eine Teilchen-Befestigungsgruppe am anderen Ende zum kovalent Binden des Molekülbindungsglieds an ein Schleifteilchen hat,
Vermischen der verbundenen Schleifteilchen

und Molekülbindungsglieder mit dem Matrixmaterial, wobei die Molekülbindungsglieder kovalent an das Matrixmaterial binden, um die Schleifteilchen sicher an dem Matrixmaterial zu befestigen, und
Härten des Matrixmaterials zur Bildung eines Kissenkörpers mit gebundenen Schleifteilchen, die im wesentlichen gleichförmig überall in dem Körper suspendiert werden.

8. Verfahren nach Anspruch 7, bei dem das Matrixmaterial aus einem polymeren Material hergestellt ist.

9. Verfahren nach Anspruch 7, bei dem der Schritt des Vermischens das Vermischen von 10 bis 50 Gew.-% verbundener Schleifteilchen und Molekülbindungsglieder mit dem Matrixmaterial aufweist.

10. Planarisiermaschine für chemisch-mechanische Planarisierung eines Halbleiterwafers, aufweisend:

eine Platte,
ein an der Platte angebrachtes Polierkissen, wobei das Polierkissen besitzt:

einen aus einem polymeren Matrixmaterial hergestellten Körper, Schleifteilchen und Molekülbindungsglieder, wobei die Molekülbindungsglieder an einem ihrer Enden eine reaktive Endgruppe haben, um kovalent an das Matrixmaterial zu binden, und an einem anderen Ende eine Teilchen-Befestigungsgruppe haben, um kovalent an ein Schleifteilchen zu binden, wodurch sie während einer chemisch-mechanischen Planarisierung in Anwesenheit einer elektrostatischen Aufschlämmung für chemisch-mechanische Planarisierung die Schleifteilchen überall im Körper an dem Matrixmaterial befestigen, und
einen Wafer-Träger, der über dem Polierkissen anordenbar ist, wobei der Wafer an dem Wafer-Träger befestigbar ist, wobei mindestens die Platte und/oder der Wafer-Träger bewegbar ist, um den Wafer mit dem Polierkissen in Eingriff zu bringen und um Bewegung zwischen den Wafer und das Polierkissen zu bringen.

11. Planarisiermaschine nach Anspruch 10, bei der das Matrixmaterial aus Polyurethan hergestellt ist.

12. Planarisiermaschine nach Anspruch 10, bei der die Schleifteilchen aus Siliciumdioxid hergestellt sind.

13. Planarisiermaschine nach Anspruch 10, bei der die Schleifteilchen aus Aluminiumoxid hergestellt sind.

14. Planarisiermaschine nach Anspruch 10, bei der das Matrixmaterial aus Polyurethan hergestellt ist und die Schleifteilchen aus Siliciumdioxid hergestellt sind.

15. Planarisiermaschine nach Anspruch 10, bei der die reaktive Endgruppe COOH ist und die Teilchen-Befestigungsgruppe ein Trichlorsilan ist, wobei das Trichlorsilan kovalent an eine hydroxylierte Siliciumoberfläche auf den Schleifteilchen bindet.

16. Polierkissen aufweisend:

- einen Körper, der aus einem polymeren Matrixmaterial hergestellt ist,
- nicht-hydrolysierte Molekülbindungsglieder,
- Schleifteilchen,
- wobei die Molekülbindungsglieder eine reaktive Endgruppe an einem Ende haben, um kovalent an das Matrixmaterial zu binden, und eine Teilchen-Befestigungsgruppe an einem anderen Ende haben, um kovalent an ein Schleifteilchen zu binden, und die Schleifteilchen während chemisch-mechanischer Planarisierung an dem Matrixmaterial zu befestigen.

17. Polierkissen nach Anspruch 16, bei dem die Schleifteilchen eine durch Dampfabscheidung aufgebrachte Beschichtung aus Molekülbindungsgliedern haben.

18. Polierkissen nach Anspruch 16, bei dem das Matrixmaterial Polyurethan ist und die Schleifteilchen Siliciumdioxid sind, und bei dem jedes Molekülbindungsglied eine reaktive Endgruppe aus COOH und eine Teilchen-Befestigungsgruppe aus Trichlorsilan hat, wobei die reaktive Endgruppe ein Molekülabschnitt an einem Ende des Molekülbindungsglieds ist, der kovalent an das Matrixmaterial bindet, und wobei die Teilchen-Befestigungsgruppe ein anderer Molekülabsabschnitt an einem anderen Ende des Molekülbindungsglieds ist.

19. Polierkissen aufweisend:

- einen Körper, der aus einem polymeren Matrixmaterial hergestellt ist, wobei der Körper zwischen etwa 50 und 90 Gew.-% des Polierkissens ausmacht,
- nicht-hydrolysierte Molekülbindungsglieder,
- Schleifteilchen, die zwischen etwa 10 und 50 Gew.-% des Polierkissens ausmachen,

wobei die Molekülbindungsglieder eine reaktive Endgruppe an einem Ende haben, um kovalent an das Matrixmaterial zu binden, und eine Teilchen-Befestigungsgruppe an einem anderen Ende haben, um kovalent an ein Schleifteilchen zu binden,

und die Schleifteilchen während chemisch-mechanischer Planarisierung an dem Matrixmaterial befestigen.

20. Polierkissen nach Anspruch 19, bei dem die Schleifteilchen eine durch Dampfabscheidung aufgebrachte Beschichtung aus Molekülbindungsgliedern haben.

21. Polierkissen nach Anspruch 19, bei dem die Schleifteilchen zwischen etwa 15 und 25 Gew.-% des Polierkissens ausmachen.

22. Polierkissen nach Anspruch 19, bei dem das Matrixmaterial Polyurethan ist und die Schleifteilchen Siliciumdioxid sind, und bei dem jedes Molekülbindungsglied eine reaktive Endgruppe aus COOH und eine Teilchen-Befestigungsgruppe aus Trichlorsilan aufweist, wobei die reaktive Endgruppe ein Molekülsegment an einem Ende des Molekülbindungsglieds ist, das kovalent an das Matrixmaterial bindet, und wobei die Teilchen-Befestigungsgruppe ein anderes Molekülsegment an einem anderen Ende des Molekülbindungsglieds ist, das kovalent an ein Schleifteilchen bindet.

23. Polierkissen aufweisend:

- einen Körper, der aus einem polymeren Matrixmaterial hergestellt ist,
- nicht-hydrolysierte Molekülbindungsglieder,
- Schleifteilchen mit einer mittleren Teilchengröße von weniger als 0,15 µm,

wobei die Molekülbindungsglieder eine reaktive Endgruppe an einem Ende haben, um kovalent an das Matrixmaterial zu binden, und eine Teilchen-Befestigungsgruppe an einem anderen Ende haben, um kovalent an ein Schleifteilchen zu binden, und die Schleifteilchen während chemisch-mechanischer Planarisierung in Anwesenheit einer elektrostatischen Lösung für chemisch-mechanische Planarisierung an dem Matrixmaterial befestigen.

24. Polierkissen nach Anspruch 23, bei dem die Schleifteilchen eine mittlere Teilchengröße von weniger als 0,1 µm haben.

25. Polierkissen nach Anspruch 23, bei dem der Körper zwischen etwa 50 und 90 Gew.-% des Polierkissens ausmacht und die Schleifteilchen zwischen etwa 10 und 50 Gew.-% des Polierkissens ausmachen.

Revendications

1. Tampon à polir des plaquettes en semi-conducteur, comprenant :

- un corps constitué d'un matériau de matrice polymère ;
- des particules abrasives ; et
- des liens de fixation moléculaire ;

Les liens de fixation moléculaire comprenant un groupe terminal réactif à une extrémité de ceux-ci et un groupe de fixation de particule à l'autre extrémité de ceux-ci, le groupe terminal réactif se liant de manière covalente au matériau de matrice et le groupe de fixation de particule se liant de manière covalente à une particule abrasive, fixant ainsi les particules abrasives au matériau de matrice suivant une distribution sensiblement uniforme dans l'ensemble du corps et d'une manière capable de maintenir sensiblement la fixation entre les particules abrasives et le matériau de matrice en présence d'une suspension épaisse de planarisation chimique-mécanique électrostatique.

2. Tampon à polir selon la revendication 1 dans lequel le matériau de matrice est constitué de polyuréthane.

3. Tampon à polir selon la revendication 1 dans lequel les particules abrasives sont constituées de dioxyde de silicium.

4. Tampon à polir selon la revendication 1 dans lequel les particules abrasives sont constituées d'oxyde d'aluminium.

5. Tampon à polir selon la revendication 1 dans lequel le matériau de matrice est constitué de polyuréthane et les particules abrasives sont constituées de dioxyde de silicium.

6. Tampon à polir selon la revendication 5 dans lequel le groupe terminal réactif est COOH et le groupe de fixation de particule est un trichlorosilane, le trichlorosilane se liant de manière covalente à la surface de silicium hydroxylé sur les particules abrasives.

7. Procédé de fabrication d'un tampon à polir à particules liées pour utilisation dans la planarisation chimique-mécanique de plaquettes en semi-conducteur, comprenant les étapes consistant à :

remplir un moule avec un matériau de matrice ;

lier de manière covalente des liens de fixation moléculaire à des particules abrasives, chaque lien de fixation moléculaire comprenant un groupe terminal réactif à une extrémité pour lier de manière covalente le lien de fixation moléculaire au matériau de matrice et un groupe de

fixation de particule à l'autre extrémité pour lier de manière covalente le lien de fixation moléculaire à une particule abrasive ;

mélanger les particules abrasives et liens de fixation moléculaire liés avec le matériau de matrice, les liens de fixation moléculaire se liant de manière covalente au matériau de matrice pour fixer solidement les particules abrasives au matériau de matrice ; et

durcir le matériau de matrice pour former un corps de tampon comprenant des particules abrasives liées qui sont en suspension sensiblement uniforme dans l'ensemble du corps.

8. Procédé selon la revendication 7 dans lequel le matériau de matrice est constitué de matériau polymère.

9. Procédé selon la revendication 7 dans lequel l'étape de mélange comprend le mélange de 10 % à 50 % en poids de particules abrasives et liens de fixation moléculaire liés au matériau de matrice.

10. Machine de planarisation pour la planarisation chimique-mécanique d'une plaquette en semi-conducteur, comprenant :

une platine ;

un tampon à polir positionné sur la platine, le tampon à polir comprenant

un corps constitué d'un matériau de matrice polymère, des particules abrasives et des liens de fixation moléculaire, les liens de fixation moléculaire comprenant un groupe terminal réactif à une extrémité de ceux-ci pour se lier de manière covalente au matériau de matrice et un groupe de fixation de particule à une autre extrémité pour se lier de manière covalente à une particule abrasive, de manière à fixer les particules abrasives au matériau de matrice dans l'ensemble du corps pendant la planarisation chimique-mécanique en présence d'une suspension épaisse de planarisation chimique-mécanique électrostatique, et

un support de plaquette positionnable au-dessus du tampon à polir, la plaquette pouvant être fixée au support de plaquette, dans laquelle au moins l'un parmi la platine ou le support de plaquette est mobile pour mettre en prise la plaquette avec le tampon à polir et provoquer un mouvement entre la plaquette et le tampon à polir.

11. Machine de planarisation selon la revendication 10 dans laquelle le matériau de matrice est constitué de polyuréthane.

12. Machine de planarisation selon la revendication 10 dans laquelle les particules abrasives sont constituées de dioxyde de silicium.

13. Machine de planarisation selon la revendication 10 dans laquelle les particules abrasives sont constituées d'oxyde d'aluminium.

14. Machine de planarisation selon la revendication 10 dans laquelle le matériau de matrice est constitué de polyuréthane et les particules abrasives sont constituées d'oxyde d'aluminium.

15. Machine de planarisation selon la revendication 10 dans laquelle le groupe terminal réactif est COOH, et le groupe de fixation de particule est un trichlorosilane, le trichlorosilane se liant de manière covalente à la surface de silicium hydroxylé sur les particules abrasives.

16. Tampon à polir, comprenant :

- un corps constitué de matériau de matrice polymère ;
- des liens de fixation moléculaire non hydrolyses ;
- des particules abrasives ;

les liens de fixation moléculaire comprenant un groupe terminal réactif à une extrémité pour se lier de manière covalente au matériau de matrice et un groupe de fixation de particule à une autre extrémité pour se lier de manière covalente à une particule abrasive et fixer les particules abrasives au matériau de matrice pendant la planarisation chimique-mécanique.

17. Tampon à polir selon la revendication 16 dans lequel les particules abrasives comprennent un revêtement de liens de fixation moléculaire appliqué par déposition en phase gazeuse.

18. Tampon à polir selon la revendication 16 dans lequel le matériau de matrice est en polyuréthane et les particules abrasives sont en dioxyde de silicium, et dans lequel chaque lien de fixation moléculaire comprend un groupe terminal réactif COOH et un groupe de fixation de particule trichlorosilane, le groupe terminal réactif étant un segment de molécule à une extrémité du lien de fixation moléculaire qui se lie de manière covalente au matériau de matrice et le groupe de fixation de particule étant un

autre segment de molécule à une autre extrémité du lien de fixation moléculaire.

19. Tampon à polir, comprenant :

- un corps constitué d'un matériau de matrice polymère, le corps représentant environ 50 % à 90 % en poids du tampon à polir ;
- des liens de fixation moléculaire non hydrolysés ;
- des particules abrasives représentant environ 10 % à 50 % en poids du tampon à polir ;

Les liens de fixation moléculaire comprenant un groupe terminal réactif à une extrémité pour se lier de manière covalente au matériau de matrice et un groupe de fixation de particule à une autre extrémité pour se lier de manière covalente à une particule abrasive, et fixer les particules abrasives au matériau de matrice pendant la planarisation chimique-mécanique.

20. Tampon à polir selon la revendication 19 dans lequel les particules abrasives comprennent un revêtement de liens de fixation moléculaire appliqué par déposition en phase gazeuse.

21. Tampon à polir selon la revendication 19 dans lequel les particules abrasives représentent environ 15 % à 25 % en poids du tampon à polir.

22. Tampon à polir selon la revendication 19 dans lequel le matériau de matrice est en polyuréthane et les particules abrasives sont en dioxyde de silicium, et dans lequel chaque lien de fixation moléculaire comprend un groupe terminal réactif COOH et un groupe de fixation de particule trichlorosilane, le groupe terminal réactif étant un segment de molécule à une extrémité du lien de fixation moléculaire qui se lie de manière covalente au matériau de matrice et le groupe de fixation de particule étant un autre segment de molécule à une autre extrémité du lien de fixation moléculaire qui se lie de manière covalente à une particule abrasive.

23. Tampon à polir, comprenant :

- un corps constitué de matériau de matrice polymère ;
- des liens de fixation moléculaire non hydrolysés ;
- des particules abrasives ayant une taille de particule moyenne inférieure à 0,15 µm ;

les liens de fixation moléculaire comprenant un groupe terminal réactif à une extrémité pour se lier de manière covalente au matériau de matrice et un groupe de fixation de particule à une autre extrémité pour se lier de manière covalente à une particule abrasive et fixer les particules abrasives au matériau de matrice pendant la planarisation chimique-mécanique en présence d'une solution de planarisation chimique-mécanique électrostatique.

24. Tampon à polir selon la revendication 23, dans lequel les particules abrasives ont une taille de particule moyenne inférieure à 0,1 µm.

25. Tampon à polir selon la revendication 23, dans lequel le corps représente environ 50 % à 90 % en poids du tampon à polir et les particules abrasives représentent environ 10 % à 50 % en poids du tampon à polir.

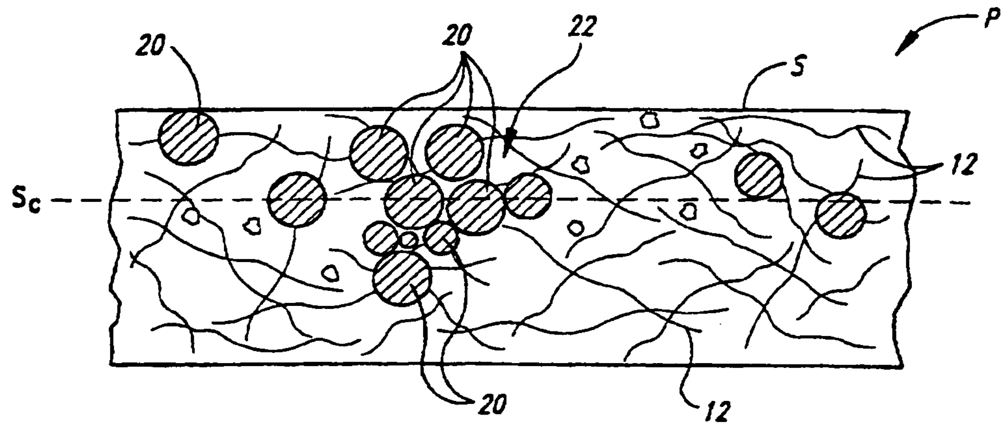

Fig. 1 (PRIOR ART)

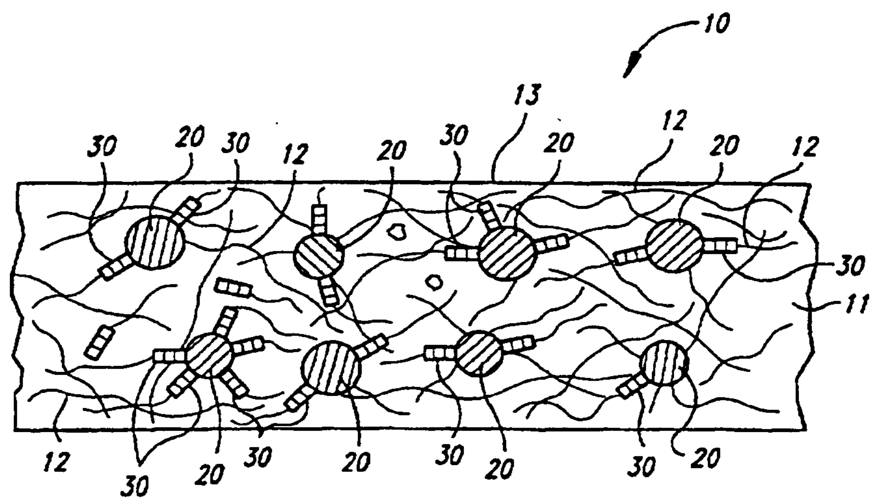

Fig. 2

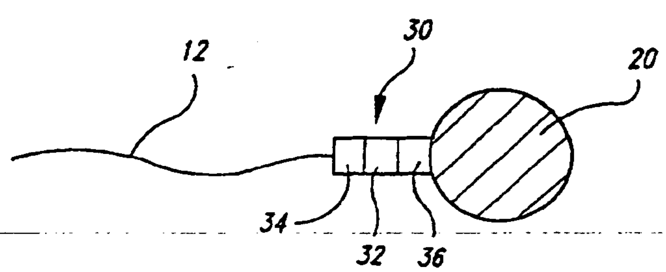

Fig. 3

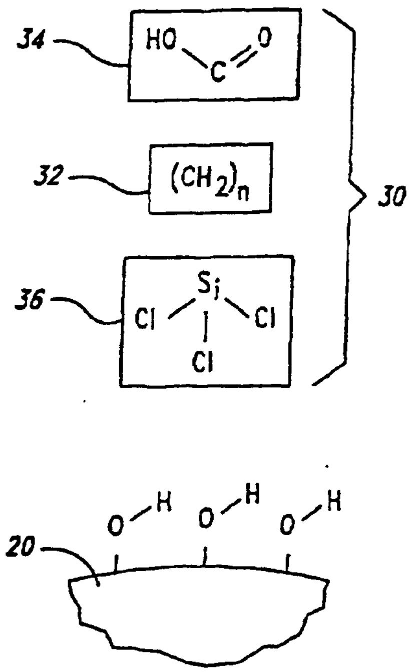

Fig. 4A

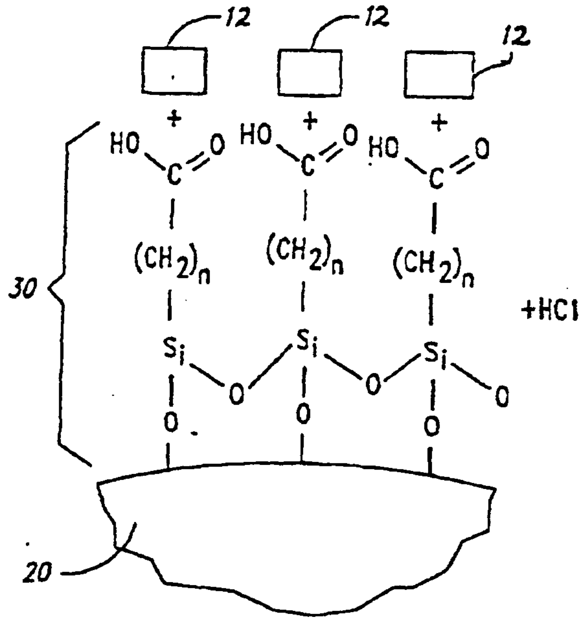

Fig. 4B

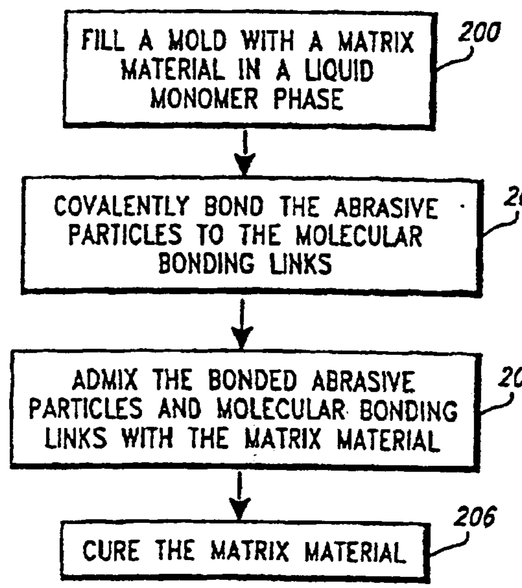

Fig. 5

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Applic. #

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